Appendix A: Supporting Figures for Section 3.2.2 (Model Simulations)

These animations (**Figures A-1 through A-7**) provide context for the still images shown in Section 3.2.2.

Figure A-1. RAQMS-modeled ozone at the 300 K isentrope-level from May 24 at 12:00 UTC to May 29 at 12:00 UTC. The model was initialized at 12:00 UTC on May 24.

Figure A-2. RAQMS-modeled ozone at the 310 K isentrope-level from May 24 at 12:00 UTC to May 29 at 12:00 UTC. The model was initialized at 12:00 UTC on May 24.

Figure A-3. RAQMS-modeled cross-section of ozone from May 24 at 12:00 UTC to May 29 at 12:00 UTC. The model was initialized at 12:00 UTC on May 24. The red box represents the approximate area of stratospheric intrusion.

Figure A-4. RAQMS-modeled CO at the 310 K isentrope-level from May 24 at 12:00 UTC to May 29 at 12:00 UTC. The model was initialized at 12:00 UTC on May 24.

Figure A-5. RAQMS-modeled cross-section of CO from May 24 at 12:00 UTC to May 29 at 12:00 UTC. The model was initialized at 12:00 UTC on May 24.

Figure A-6. WACCM-modeled ozone at the 500 mb level on May 24 at 0:00 UTC to May 29 at 00:00 UTC, with a minimum contour of 60 ppb and a maximum contour of 140 ppb.

Figure A-7. WACCM-modeled CO at the 500 mb level on May 24 at 0:00 UTC to May 29 at 00:00 UTC, with a minimum contour of 50 ppb and a maximum contour of 150 ppb.

WACCM cross-sections of CO concentrations were mostly inconclusive near the SOI event over Idaho, Montana, and Utah on May 25 and over Clark County on May 29. The May 29 image does show low CO concentrations above 36 north latitude on the EE date.

Figure A-8 shows two vertical WACCM cross sections for CO concentrations from the approximate time of the stratospheric intrusion on May 25 at 06:00 UTC and the event date of May 29 at 00:00 UTC (May 28 at 16:00 PST). A subtle trough of low-CO air extended into the upper troposphere near 50-degrees N on May 25 at 06:00 UTC (left, circled in purple) and extended to lower layers of the atmosphere by May 29 at 00:00 UTC. Concentrations of CO in these regions is at or below

approximately 100 ppb. The extent of these low-CO intrusions, however, is not as prominent as those of the ozone intrusions presented in the main text (Section 3.2.2).

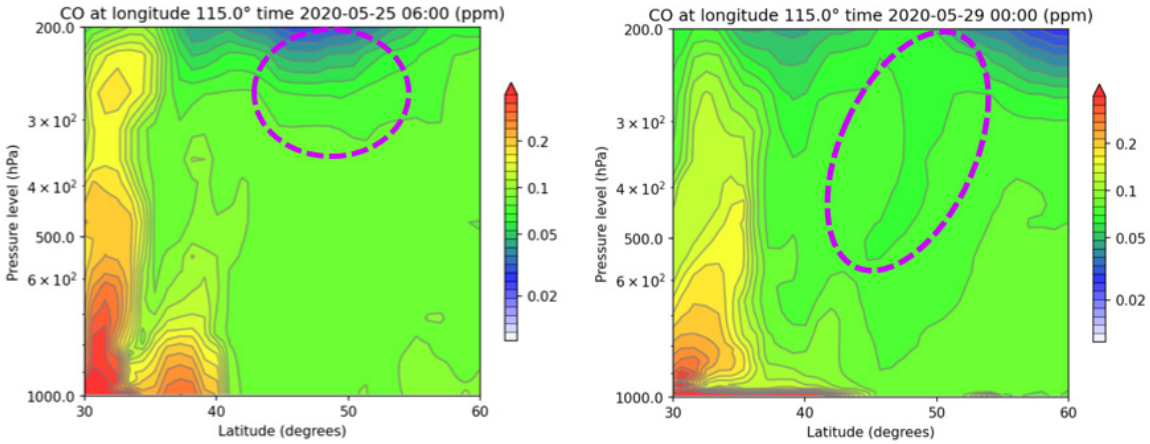

Figure A-8. WACCM-modeled cross-section of CO concentrations along the 115-degrees W longitude line on May 25 at 06:00 UTC (left) and May 29 at 00:00 UTC (the event date–May 28 at 16:00 PST) (right). The trough of reduced CO extending from the stratosphere into the upper troposphere is circled in purple.

Appendix B. Figures and Tables Supporting Section 3.5.1 (Matching Day Analysis)

Identification of matching (meteorologically similar) days includes a comparison of meteorology maps between May 28, 2020, and each date subset from candidate matching days. Surface and upper-level maps for May 28 and each date listed in Table 3-10 in Section 3.5.1 show highly consistent conditions. All dates show a surface low pressure system over Clark County. Surface maps for May 28 and each date in Table 3-10 are shown in **Figure B-1 through B-11**. Each upper-level map shows a region of high pressure over Clark County. The 500 mb maps for May 28 and each date in Table 3-10 are shown in **Figure B-12 through B-22**.

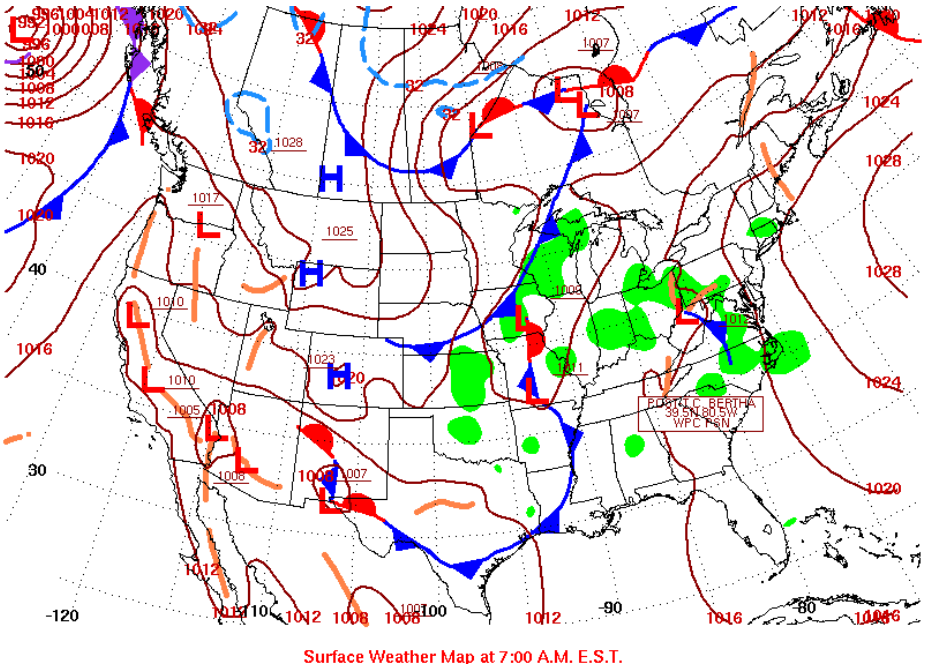

Figure B-1. Surface meteorology map on May 28, 2020 (the event date).

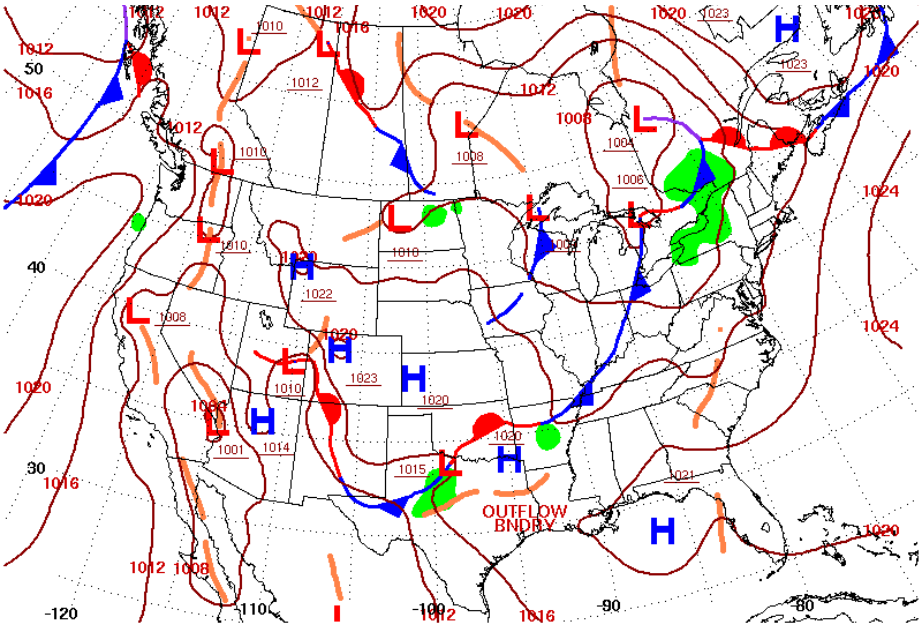

Figure B-2. Surface meteorology map on July 1, 2017.

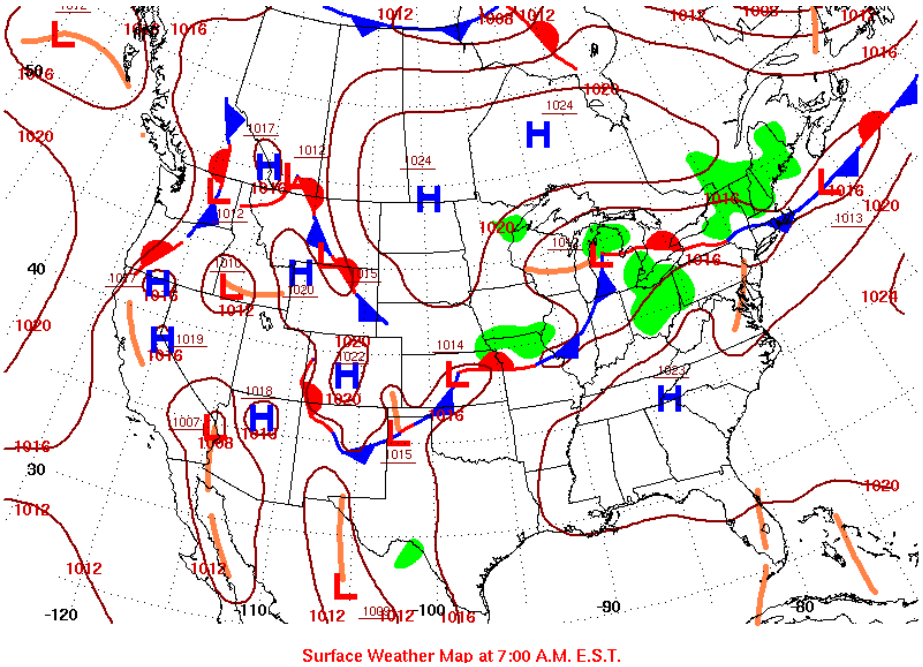

Figure B-3. Surface meteorology map on July 13, 2017.

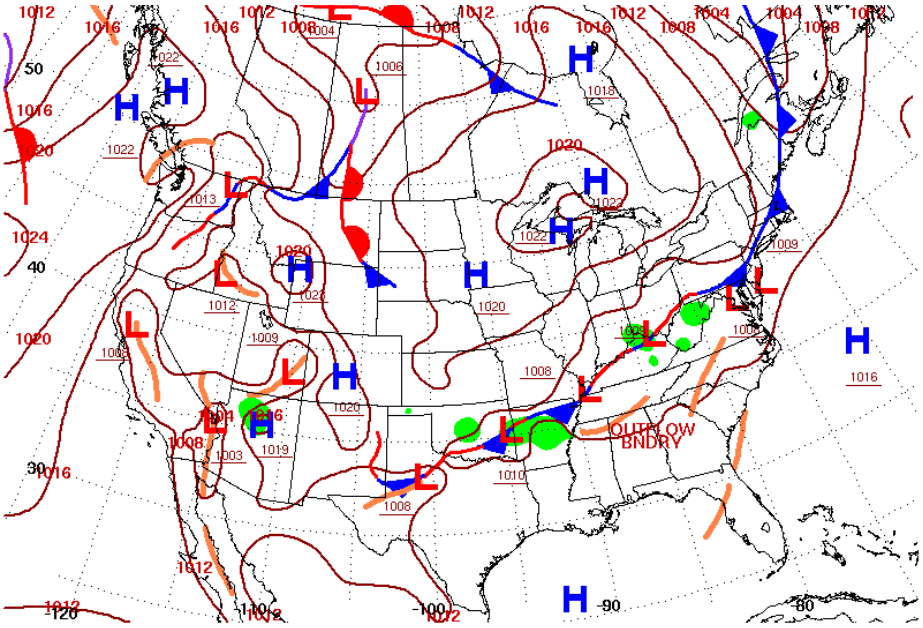

Figure B-4. Surface meteorology map on July 28, 2017.

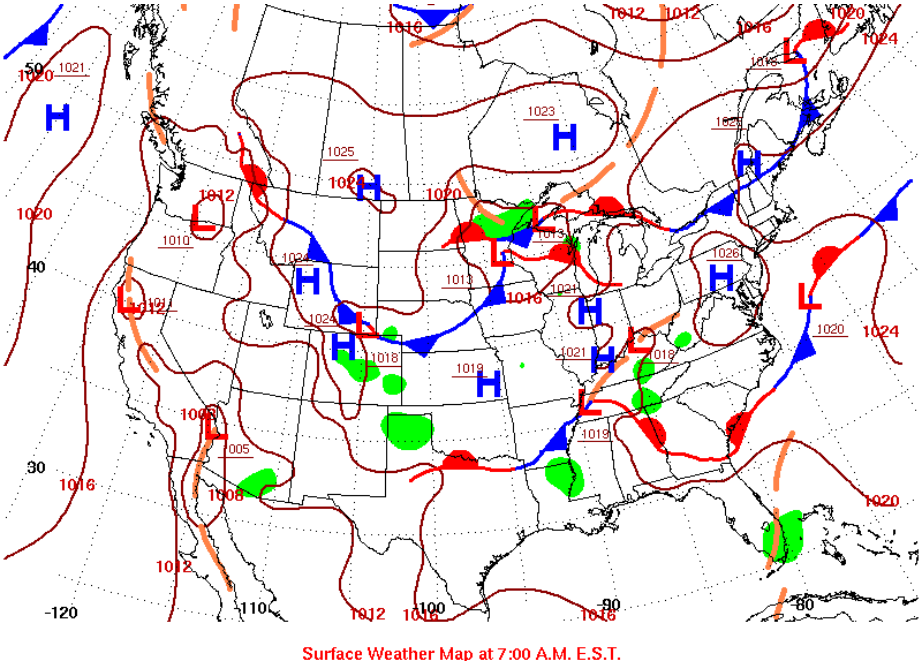

Figure B-5. Surface meteorology map on August 10, 2017.

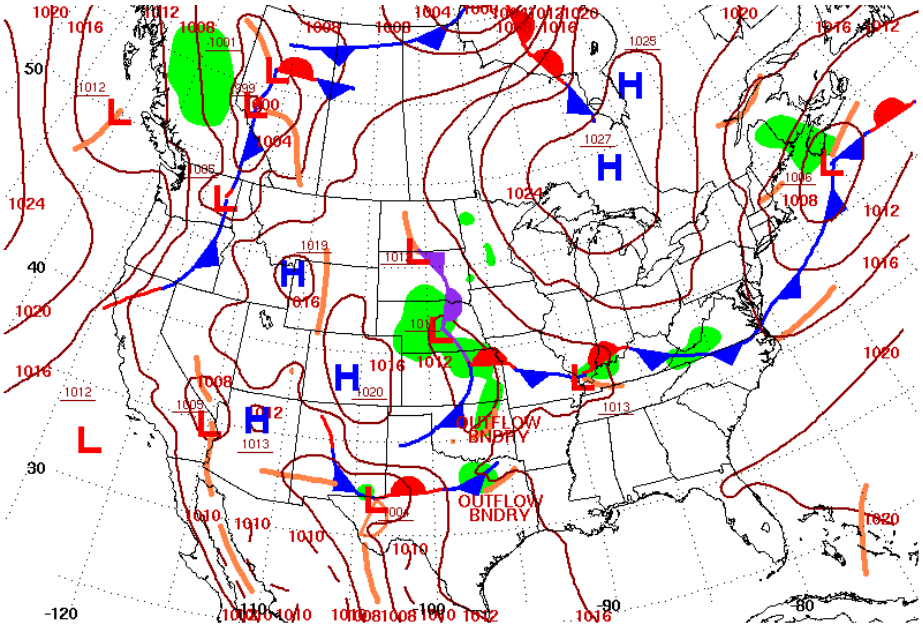

Figure B-6. Surface meteorology map on June 25, 2018.

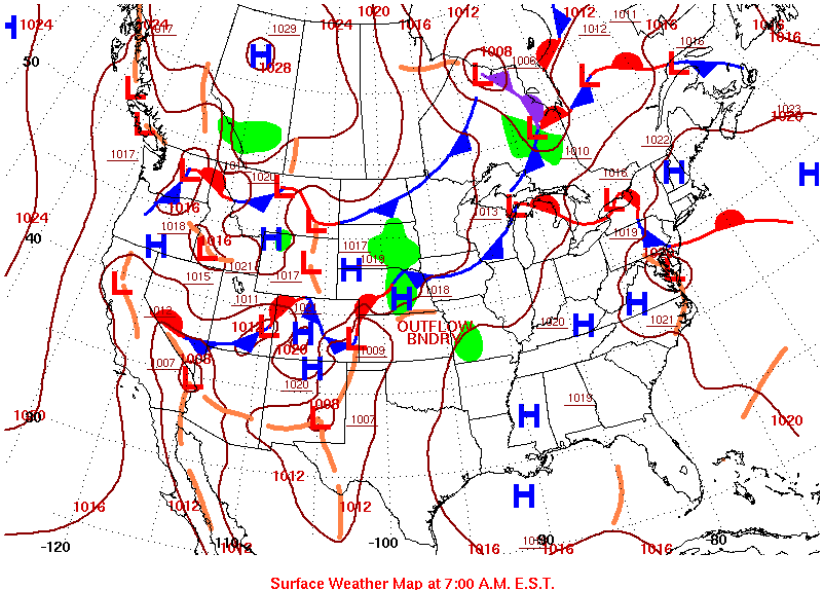

Figure B-7. Surface meteorology map on July 5, 2019.

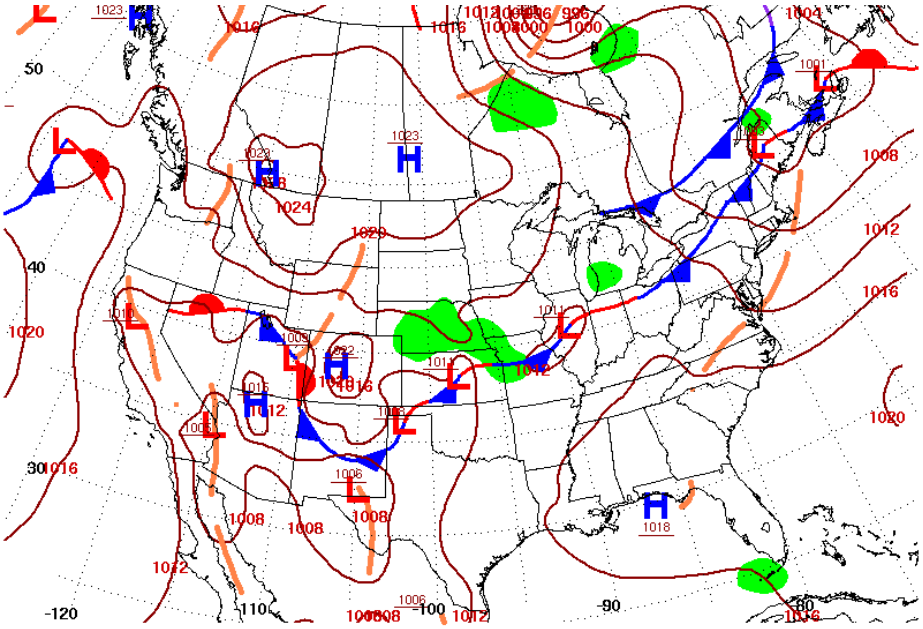

Figure B-8. Surface meteorology map on July 21, 2019.

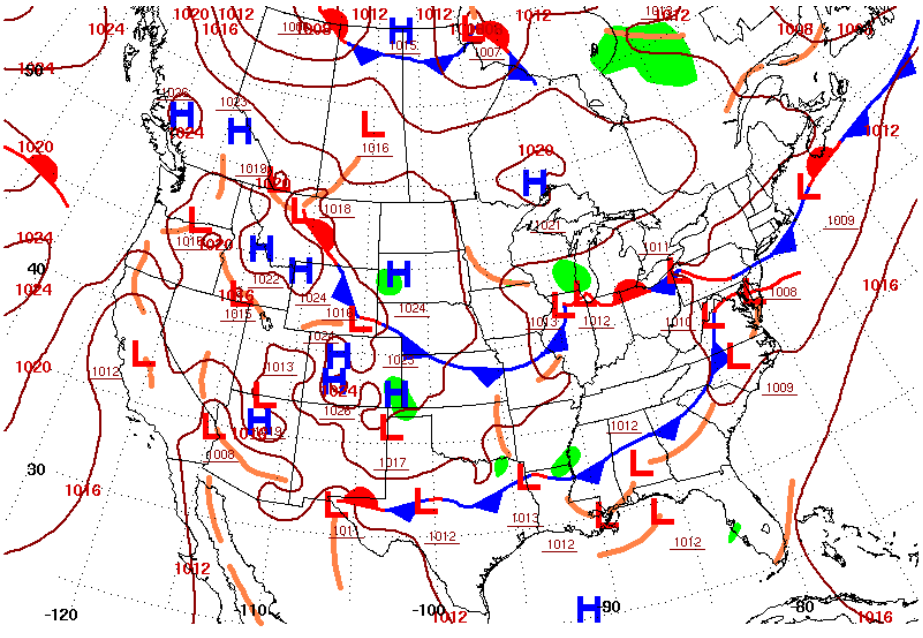

Figure B-9. Surface meteorology map on August 14, 2019.

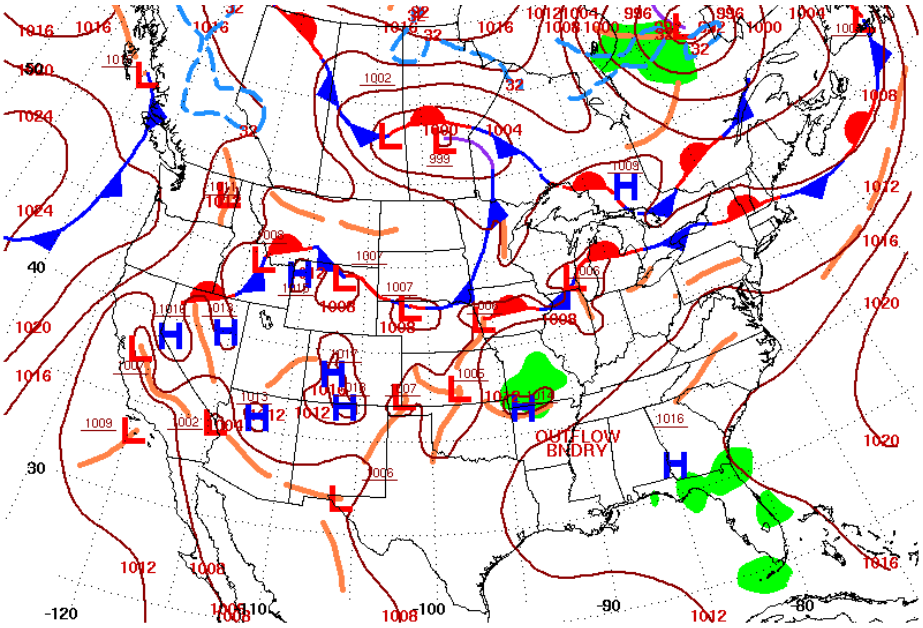

Figure B-10. Surface meteorology map on June 4, 2020.

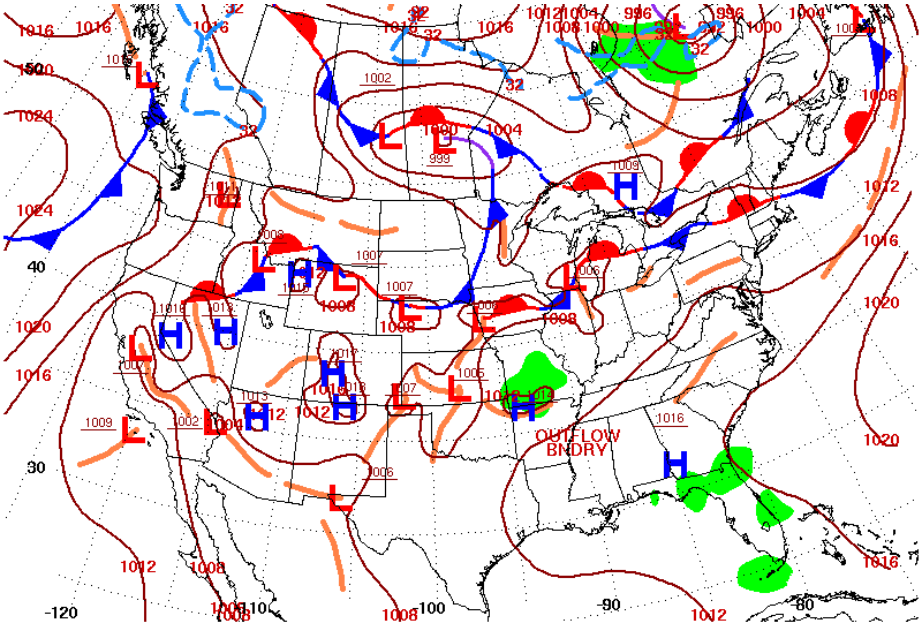

Figure B-11. Surface meteorology map on July 11, 2020.

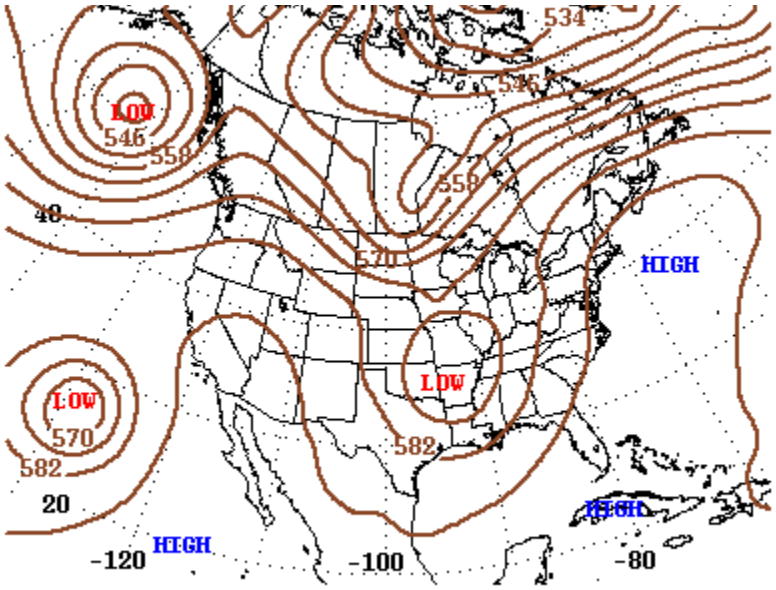

Figure B-12. 500 mb meteorology map on May 28, 2020 (the event date).

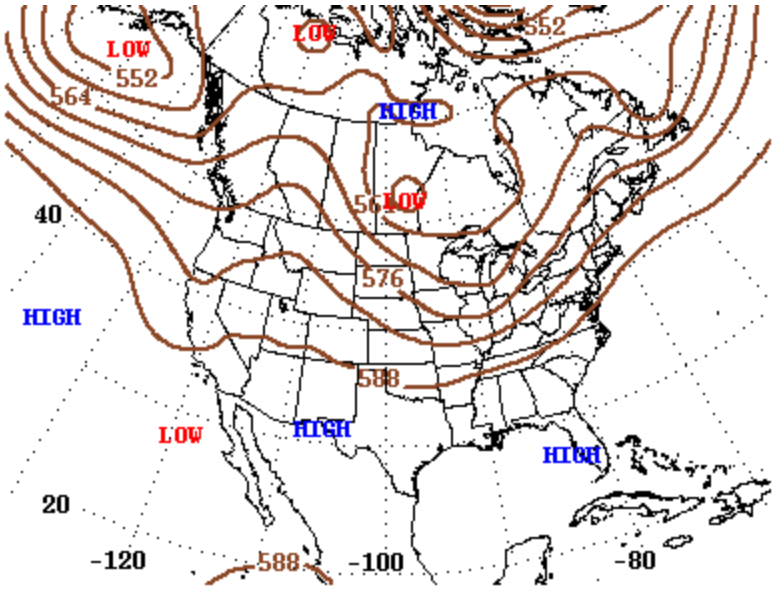

Figure B-13. 500 mb meteorology map on July 1, 2017.

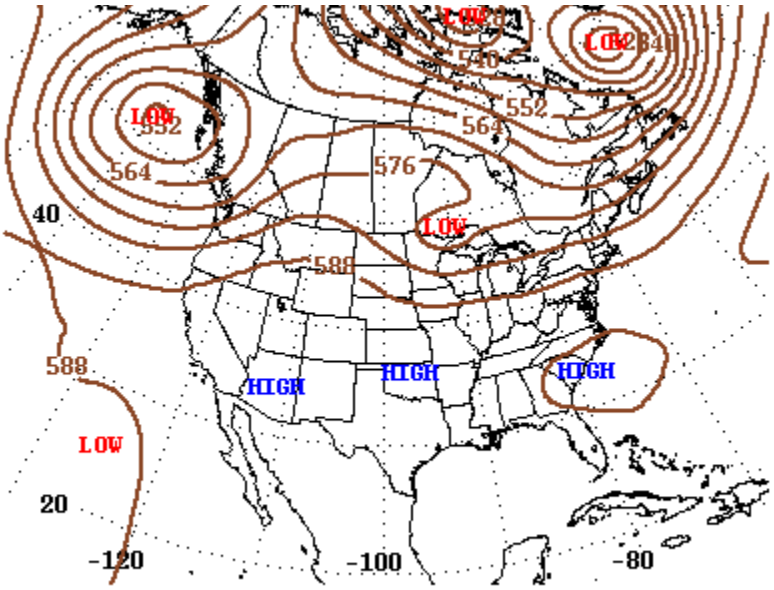

Figure B-14. 500 mb meteorology map on July 13, 2017.

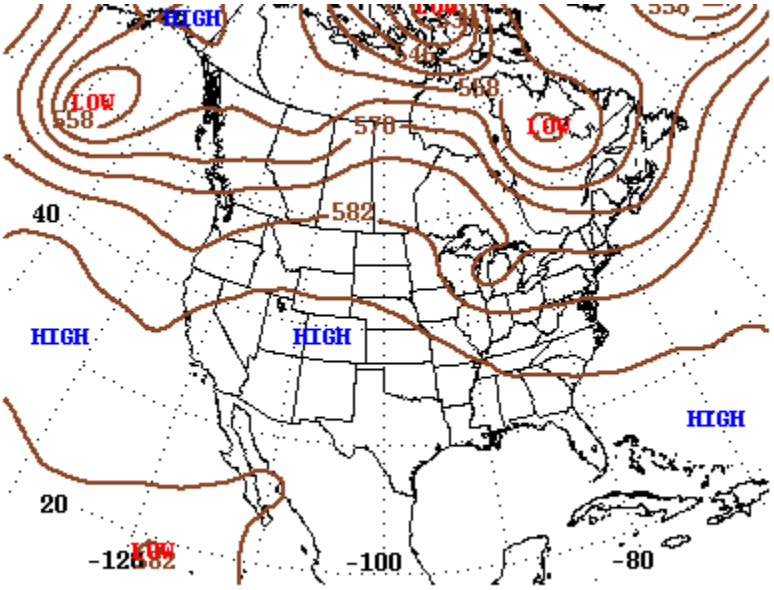

Figure B-15. 500 mb meteorology map on July 28, 2017.

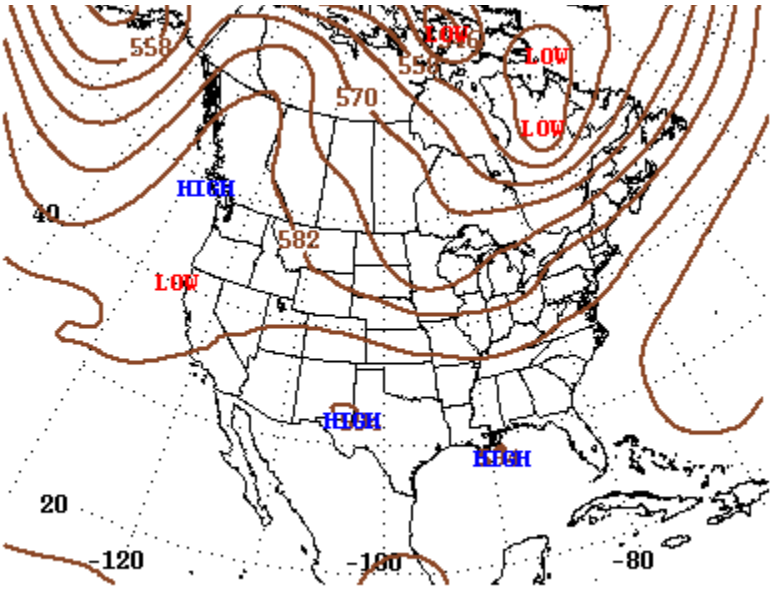

Figure B-16. 500 mb meteorology map on August 10, 2017.

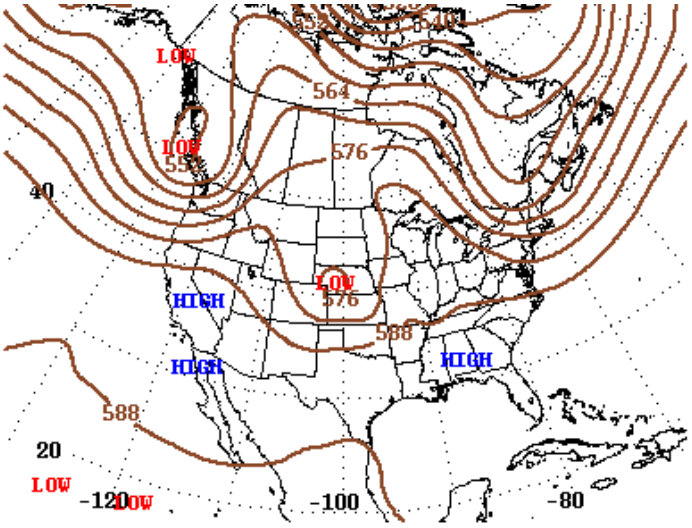

Figure B-17. 500 mb meteorology map on June 25, 2018.

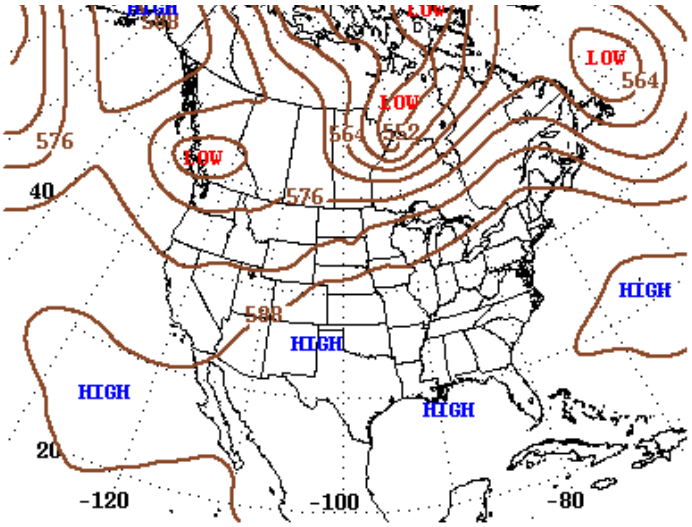

Figure B-18. 500 mb meteorology map on July 5, 2019.

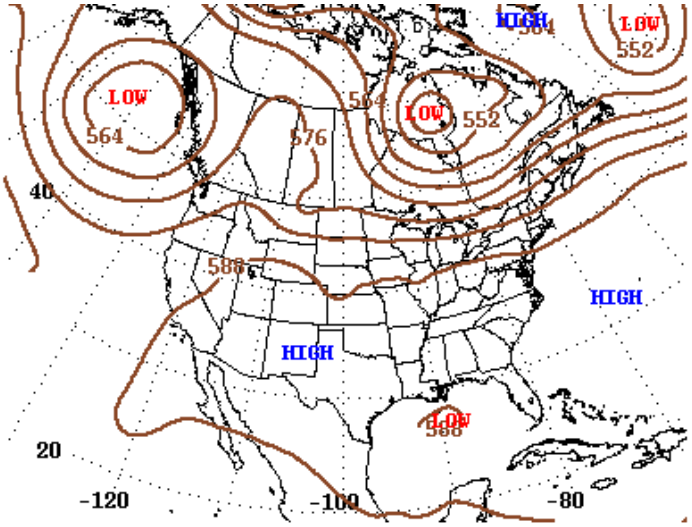

Figure B-19. 500 mb meteorology map on July 21, 2019.

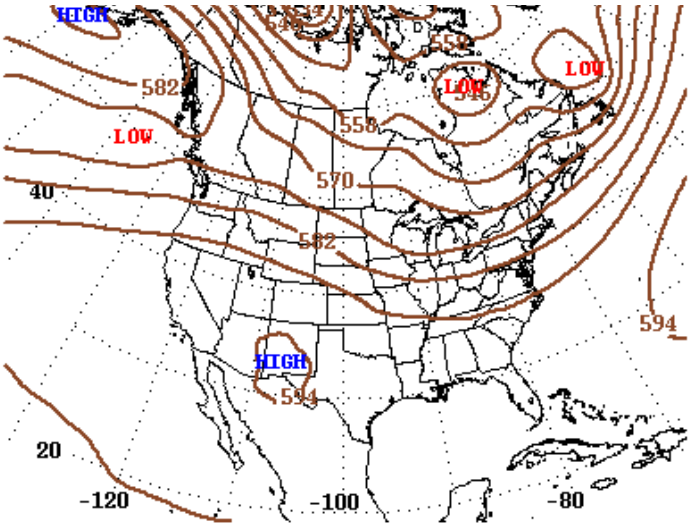

Figure B-20. 500 mb meteorology map on August 14, 2019.

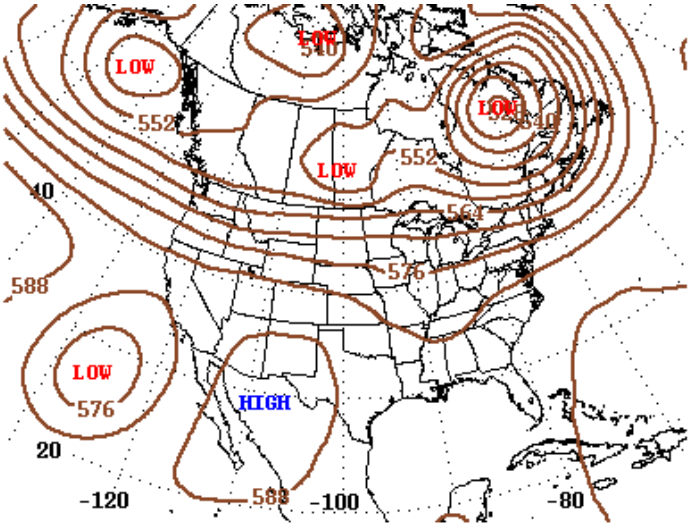

Figure B-21. 500 mb meteorology map on June 4, 2020.

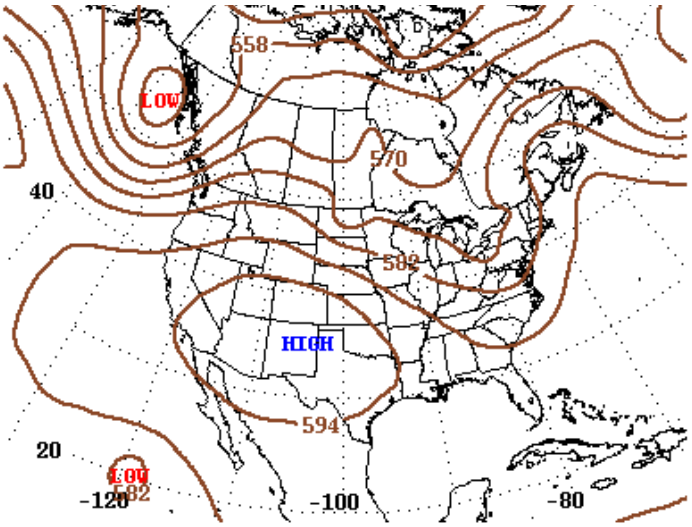

Figure B-22. 500 mb meteorology map on July 11, 2020.

Appendix C. GAM Residual Histograms and Scatter Plots from Concurred Exceptional Event Demonstrations

The following are GAM residual histograms and scatter plots from the concurred Arizona Department of Environmental Quality demonstration (Arizona Department of Environmental Quality 2016) and the submitted Texas Commission on Environmental Quality demonstration (Texas Commission on Environmental Quality 2021) for comparison with our GAM residual analysis. The figures in this Appendix show the good residual results from concurred and currently submitted exceptional events demonstrations to which we compared our results. Based on this comparison, we suggest that our GAM results show a well-fit, unbiased model. A well-fit GAM model should show a normal distribution of residuals at all sites modeled (ADEQ example in **Figure C-1**) and show no pattern or bias between GAM residuals and predicted values (TCEQ example in **Figure C-2**). These figures compare well with our GAM results in Section 3.5.2 of the main report.

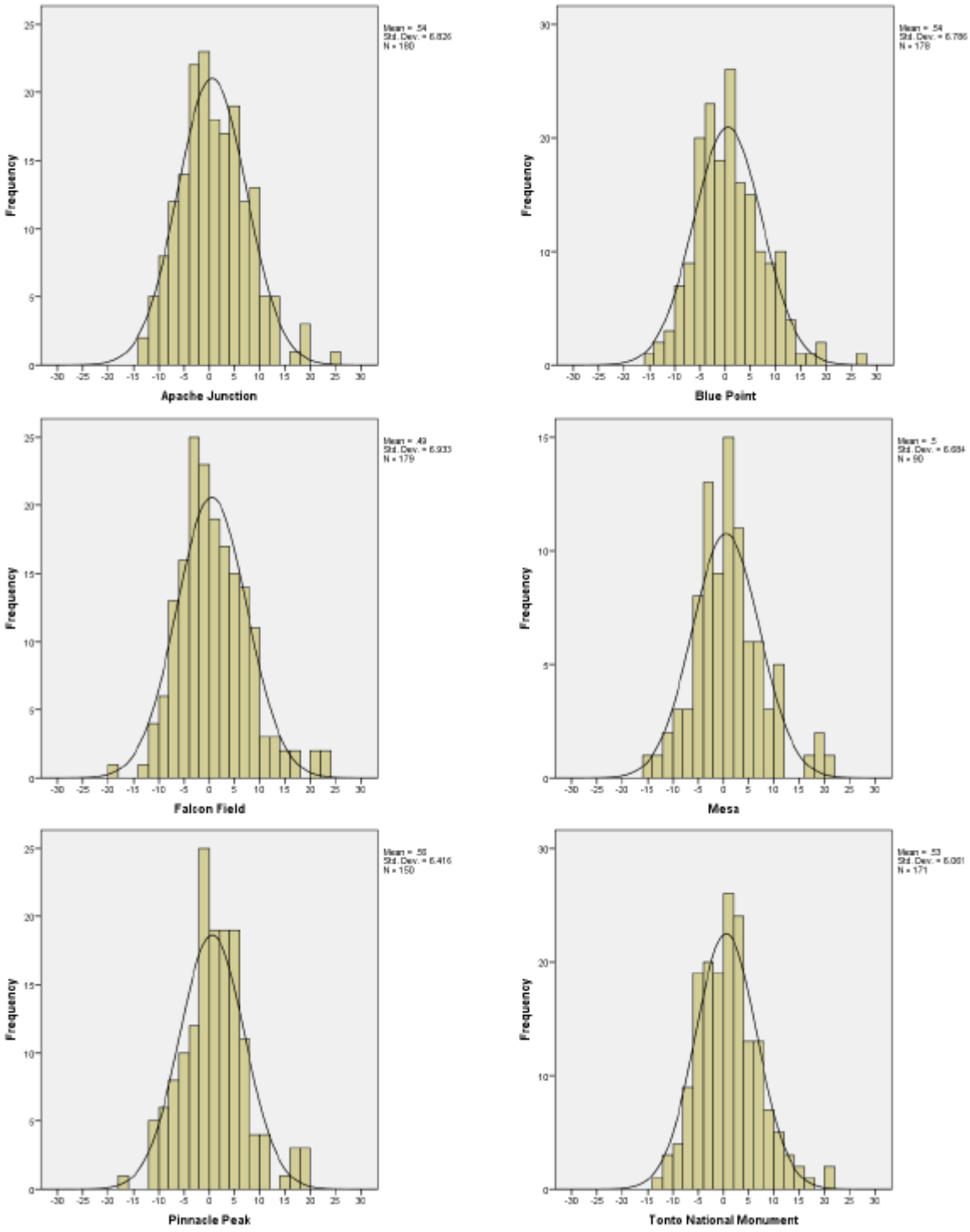

Figure C-1. Histograms of residuals results at each monitoring site from the Arizona DEQ GAM Analysis (Arizona Department of Environmental Quality 2016).

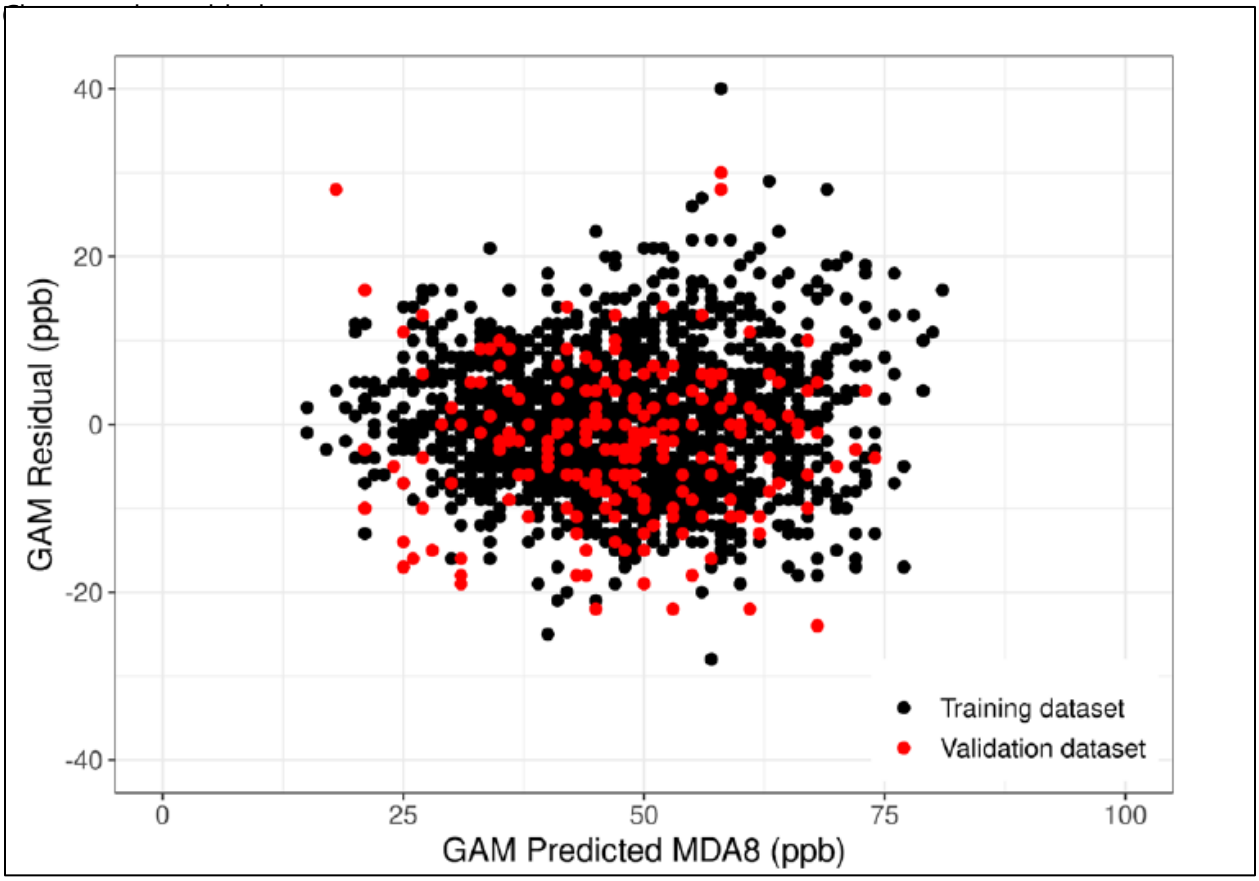

Figure C-2. Scatter plot of GAM residuals (observed – GAM predicted MDA8 ozone) vs. GAM predicted MDA8 ozone from the TCEQ submitted GAM analysis. Training data is shown in black and validation data is shown in red (Texas Commission on Environmental Quality 2021).

References

Arizona Department of Environmental Quality (2016) State of Arizona exceptional event documentation for wildfire-caused ozone exceedances on June 20, 2015 in the Maricopa nonattainment area. Final report, September. Available at https://static.azdeq.gov/pn/1609_ee_report.pdf.

Texas Commission on Environmental Quality (2021) Dallas-Fort Worth area exceptional event demonstration for ozone on August 16, 17, and 21, 2020. April. Available at https://www.tceq.texas.gov/assets/public/airquality/airmod/docs/ozoneExceptionalEvent/2020-DFW-EE-Ozone.pdf.

Appendix D. Documentation of the Public Comment Process

To be updated once public comment is received.